

LBYCV3B – Construction Materials and Testing Laboratory

Group No.	Group Members
	1. Caringal, Janna Graziella M.
	2. Felix, Francine Kyle Chloe G.
	3. Ongto. Arianna Michaela S.
	4. Villanueva, Daniel Kenneth

Experiment No. 9 Fresh Properties of Concrete

I. Introduction

An appropriate mix for concrete design is significant as it serves as a foundation of a durable structure. Mix design involves preparing a mix of cement, water, gravel, and sand to attain a desired strength, durability, and workability. After computing a preliminary mix design, a 20 liter trial batch was performed to determine if the mix design is the same with the desired properties of the fresh concrete. Mix design can be done using two methods, weight basis and the absolute volume method.

The following are the objectives of this experiment:

- Create a test concrete using Absolute volume method.
- Test the created concrete by comparing the slump and the yield of the concrete created with the slump and yield desired.
- Create another test concrete that is adjusted based on the slump and yield of the previously created concrete.
- Ultimately, create the desired concrete using the known properties of the concrete and check and make adjustments using the slump and the yield of the concrete.

II. Procedure

The following steps are conducted in the experiment:

Preparation of Materials:

- Materials will be taken to a constant temperature with a range of 20-30
- There should be no lumps present in the cement and it must be in a good condition.
- Well graded aggregates are preferred.

- Aggregates should be in wet or preferably in SSD condition.

Mixing Method:

- Machine mixing was chosen to be utilized out of the two methods.
- Before mixing, the mixer should be "buttered" through the use of an excess mortar that acts as the test batch.
- When using a tumble mixer, the concrete constituents must be placed following an order of 50% coarse aggregate, 100% cement, and 50% fine aggregate. And it is then dry mixed for 1 minute.
- Mix again for 2 minutes after putting 100% of water. When admixture is applied, mix it first with the water and then with the mixture.
- With the remaining coarse and fine aggregates, moderately mix it in the mixture while it's running.
- Periodically inspect the mixture's workability, finishability and consistency by stopping the mixer.
- After everything is done, operate the mixer where it is running for 3 minutes, and then it will rest for another 3 minutes, and lastly it will run 2 minutes for its final mixing, which brings a total operation time to be 11 minutes.

Test for Slump:

- A sample from the fresh concrete is the representative of the whole batch.
- Put some water in the inner surface of the cone, base plate, and tampering rod.
- Stand in the foothold of the cone to keep it in place. Fill the cone in three layers where per layer is one third the volume of the cone.
- Rod 25 strokes per layer and it must be equally distributed through rodding it in a vertical stroke in a spiral motion of the perimeter.
- Reaching the top, after rodding it, screed the surface to remove extra concrete.
- Within 5 seconds, the slump cone must be lifted having no horizontal motion.
- Determine the slump measurement instantly and record it to the nearest millimeter. However, the test will be repeated without measuring if there is a sign of shearing.

Test for Air Content:

- Prepare the air meter set, followed by a wet cloth to wipe the inner surfaces when the concrete sample is done. After the cover is clamped, confirmed if the seal is sealed shut and pressure tight.
- Using a bowl, the fresh concrete is then put into three layers where per layer is one third of the volume of the container.
- Rod 25 times each layer, penetrating 1 inch to make sure it does not reach the bottom or the previous layer.
- Slightly tap 15 times per layer using a mallet releasing air bubbles.

- Strike off extra concrete through scraping the rim of the bowl, using a straight edge with a lateral motion until no further excess of concrete present.
- Clean the rim using a cloth and be certain to not disturb the compacted concrete. Clamp the cover and cover it tightly.
- With it being sealed shut, the air bleeder and petcock valves of the air chambers are then closed, followed by air is pumped in the chamber before it reaches below the initial line.
- Wait for it to stabilize, then lightly tap the gauge. When the pointer is not in the initial mark, make the pointer to be at the exact initial mark through gradually releasing the air. Press the release lever quickly and read and record the air content determined by the pointer.
- After the test, clean the set-up and the materials used.

III. Data

Table 1: Material Properties

CEMENT	
SG	3.14
SAND	
SG (SSD)	2.37
SG (Dry)	2.25
Unit Wt. (kg/m ³)	1614
FM	2.4
Absorption	5.55%
Moisture Content	6.50%
GRAVEL	
SG (SSD)	2.82
SG (Dry)	2.78
Unit Wt. (kg/m ³)	1705
Absorption	1.40%
Moisture Content	2.30%
Coarse Aggregate Ratio	0.66
REQUIRED VALUES	
f _c (mPa)	30
W/C Ratio	0.54
Slump (mm)	100
Air Content	2.00%

Table 2.1: Trial Mix No. 1

Trial No.		W (kg)	C (kg)	G (kg)	S (kg)	Air (%)	Fresh Concrete Test Results
1	Design Mix	205.00	379.63	1125.30	560.93	2.0	Slump: 45 mm Air: 2.20 %
	Adjusted Values	189.54	379.63	1151.18	597.39		Temp.: 20-30°C
	20 - Liter Batch	3.79	7.59	23.02	11.95		Unit Wt.: 2400 kg/m ³

Table 2.2: Trial Mix No. 2

Trial No.		W (kg)	C (kg)	G (kg)	S (kg)	Air (%)	Fresh Concrete Test Results
2	Design Mix	223.44	413.78	1165.93	457.65	2.2	Slump: ____ mm Air: ____ %
	Adjusted Values	208.60	413.78	1192.75	487.4		Temp.: ____ °C
	20 - Liter Batch	4.17	8.28	23.86	9.75		Unit Wt.: ____ kg/m ³

Calculations:

Material Properties:

Specific Gravity (dry)

$$\text{Sand} = 2.37 / [1 + (5.55/100)] = 2.25$$

$$\text{Gravel} = 2.82 / [1 + (1.40/100)] = 2.78$$

Trial Mix No. 1:

Design Mix

$$C = 205 / 0.54 = 379.63 \text{ kg}$$

$$G = 1705 * 0.66 = 1125.30 \text{ kg}$$

$$\begin{aligned}
 S &= \{ 1 - [(2/100) + (205/1000) + (379.63/3.14/1000) + (1125.30/2.78/1000)] \} (2.25*1000) \\
 &= (1 - 0.7507) (2.25*1000) \\
 &= (0.2943) (2.25*1000) \\
 &= 560.93 \text{ kg}
 \end{aligned}$$

Adjusted Values

$$W = 205 - 1125.30(0.023 - 0.014) - 560.93(0.065 - 0.056) = 189.54 \text{ kg}$$

$$G = 1125.30[1 + (2.3/100)] = 1151.18 \text{ kg}$$

$$S = 560.93[1 + (6.5/100)] = 597.39 \text{ kg}$$

20-Liter Batch (wet)

$$W = 189.53*(2/100) = 3.79 \text{ kg}$$

$$C = 379.63*(2/100) = 7.59 \text{ kg}$$

$$G = 1151.18*(2/100) = 23.02 \text{ kg}$$

$$S = 597.39*(2/100) = 11.95 \text{ kg}$$

$$\text{Total Weight} = 3.79 + 7.59 + 23.02 + 11.95 = 46.35 \text{ kg}$$

20-Liter Batch (dry)

$$W = 205*(2/100) = 4.10 \text{ kg}$$

$$C = 379.63*(2/100) = 7.5926 \text{ kg}$$

$$G = 1125.3*(2/100) = 22.506 \text{ kg}$$

$$S = 560.93*(2/100) = 11.2186 \text{ kg}$$

Trial Mix No. 2:

Design Mix

$$\text{Yield} = (3.79 + 7.59 + 23.02 + 11.95)/2400 = 0.0193 \text{ m}^3$$

$$\text{Water to be added to get desired slump} = 5.5*2 = 11$$

$$W = (4.1/0.0193) + 11 = 223.44 \text{ kg}$$

$$C = 223.44 / 0.54 = 413.78 \text{ kg}$$

$$G = (23.02/0.0193)/(1+0.023) = 1165.93 \text{ kg}$$

$$\begin{aligned} S &= \{ 1 - [(2.2/100) + (223.44/1000) + (413.78/3.14/1000) + (1165.93/2.78/1000)] \} \\ &\quad (2.25*1000) \\ &= (1 - 0.7966)(2.25*1000) \\ &= (0.2034)(2.25*1000) \\ &= 457.65 \text{ kg} \end{aligned}$$

Adjusted Values

$$W = 223.44 - 1165.93(0.023 - 0.014) - 457.65(0.065 - 0.056) = 208.60 \text{ kg}$$

$$G = 1165.93 [1 + (2.3/100)] = 1192.75 \text{ kg}$$

$$S = 457.65[1 + (6.5/100)] = 487.40 \text{ kg}$$

20-Liter Batch (wet)

$$W = 208.60*(2/100) = 4.17 \text{ kg}$$

$$C = 413.78*(2/100) = 8.28 \text{ kg}$$

$$G = 1192.75*(2/100) = 23.86 \text{ kg}$$

$$S = 487.40*(2/100) = 9.75 \text{ kg}$$

IV. Conclusions

From the previous experiments, the specific gravity, absorption, and moisture contents of sand and gravel were determined. Moreover, the specific gravity of cement, fineness modulus, unit weight were also known. The first trial mix yielded a unit weight of 2400 kg/m³ and a 45 mm slump, which is far from the target slump of 100 mm by 55 mm. The air content was also

found to be 2.20% instead of the target 2.00%. The second trial mix should have been tested in order to make sure that this time, the slump that is created would be, at the very least, close to the desired value. Possible sources of error may include, the improper mixing of concrete due to human errors and errors in measuring the values from the previous experiments.

The testing of the first trial mix is important for it allows a correction of the process used to create the concrete. This is especially important since we could have major inconsistencies such as the slump being 45 mm when it should have been 100 mm. The yield based correction is simply to ensure that the concrete that would be created is neither too much or too little. The second trial mix should have been tested so that it would be known whether this time around, we have made the slump to be even close to the desired value.

V. Things Learned from the Experiment

We have learned that mix design of concrete is a process where the right proportions of water, cement, fine aggregates, and coarse aggregates are determined through various calculations and laboratory testings. The proportions that are considered to be right are determined by the targeted or required strength and durability of the structure which would be shown as a ratio of cement:sand:gravel by volume. Ultimately, the main purpose of this procedure is to determine the most accurate concrete mix design to produce the most concrete construction economically. As a result of various properties of the ingredient in the mix, there are various types of concrete based on its grade, mix ratio and compressive strength such as ordinary concrete, standard concrete, high strength concrete.

VI. References

Dhir, R. K. et al. (2018). Use of Glass Cullet in Geotechnical Applications, *Woodhead Publishing Series in Civil and Structural Engineering*, 257-296.
<https://doi.org/10.1016/B978-0-08-100984-0.00007-2>.